(12) UK Patent Application (19) GB (11) 2 326 272 (13) A

(43) Date of A Publication 16.12.1998

(21) Application No 9812469.6

(22) Date of Filing 11.06.1998

(30) Priority Data
(31) 9712243 (32) 13.06.1997 (33) GB

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(51) INT CL^6
H01J 23/02

(52) UK CL (Edition P)
H1D DKDX D18AY D18A1Y D46A D46Y

(56) Documents Cited
GB 1234517 A WO 80/00282 A

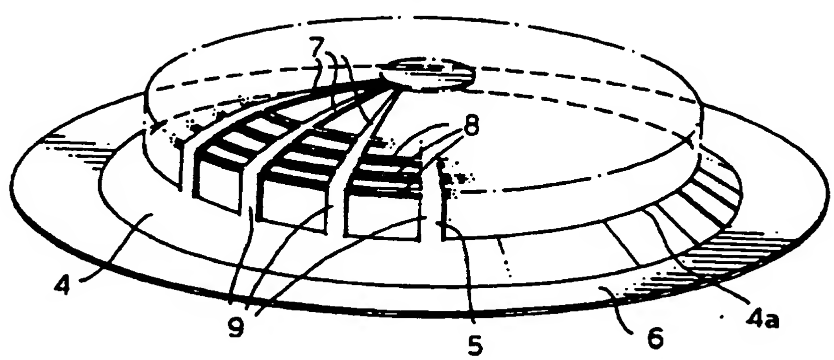
(58) Field of Search
UK CL (Edition P) H1D DKDE DKDF DKDG DKDH DKDJ DKDP DKDX
INT CL^6 H01J 1/46 3/02 23/02 23/06 23/065 23/07 23/075 23/08 23/083
online: WPI

(54) Abstract Title

Grids for electron beam tubes

(57) A grid for use in a linear electron beam tube such as an IOT or TWT includes a grid section 7,8 and a focus electrode 4 between which is included an accommodation portion 5. The grid is mounted in the tube by a mounting flange 6 around its outer periphery. During use, the grid section 7,8 becomes hot and consequently expands but the mounting flange 6 remains relatively cool being connected to a relatively massive structure. Thin flexible strips 9 of the accommodation section 5 permit movement between the mounting flange 6 and the grid section 7,8 due to differential thermal expansion, thus minimising distortion to the grid section which might otherwise occur if it were connected directly to the mounting flange 6 and hence fixed in its outer diameter length.

Fig.3.



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At least one drawing originally filed was informal...

Fig.1.

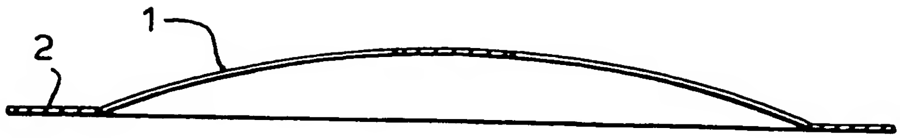


Fig.2.

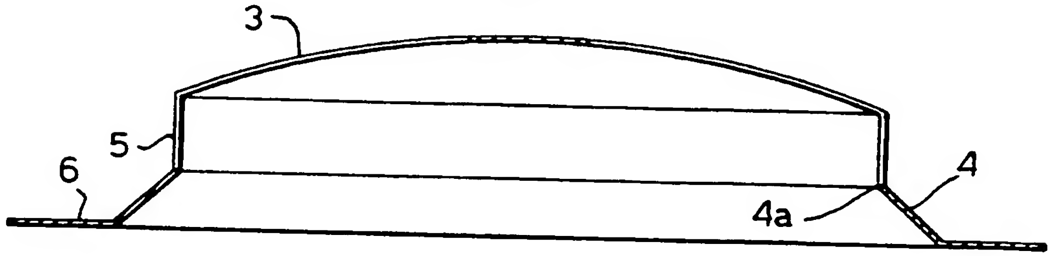


Fig.3.

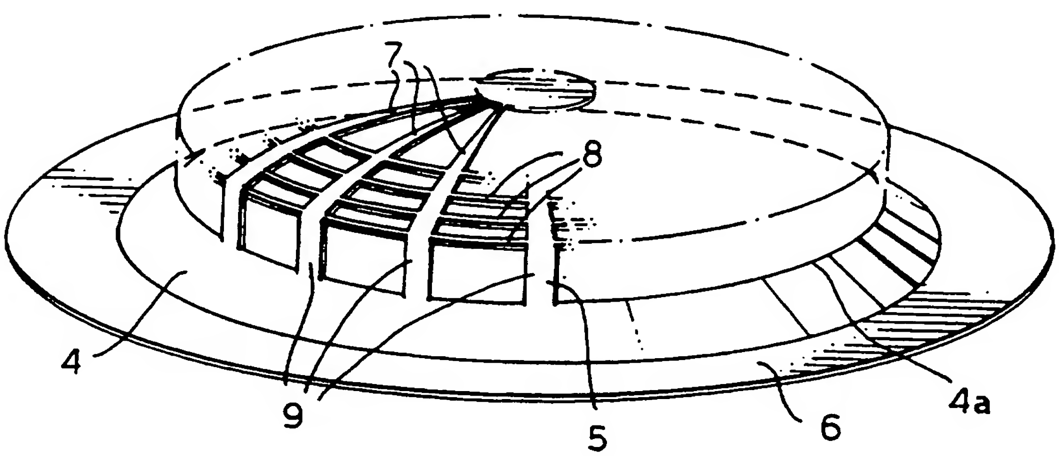
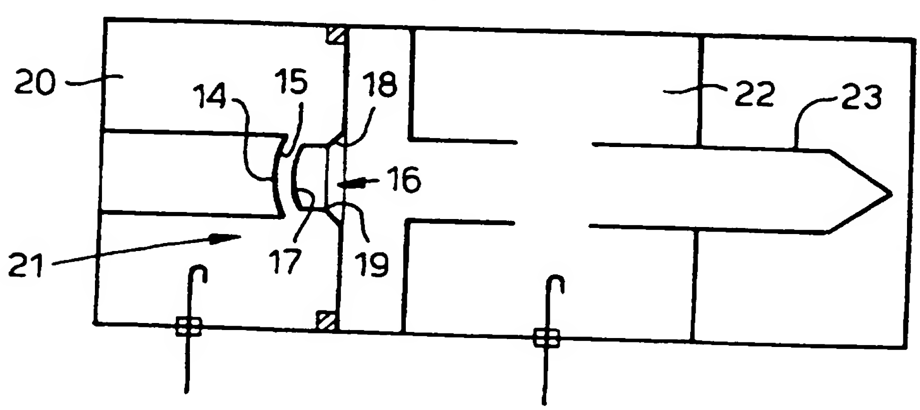


Fig.4.



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GRIDS

This invention relates to grids and more particularly grids for use in linear beam tubes such as inductive output tubes (IOTs).

In an IOT, an electron beam is produced at a cathode and arranged to interact with an applied high frequency signal to give an amplified high frequency output signal. A grid is located in front of the cathode to control the density of the electron beam, the high frequency signal being applied across the gap between the cathode and the grid to modulate the beam density. The cathode and grid must therefore be accurately located relative to one another. A focus electrode is normally used to define the profile of the electron beam. Other types of linear beam tubes also employ grids, for example, they are also used in travelling wave tubes (TWTs). During operation, the grid gets hot, which may cause problems in controlling the electron beam density.

The present invention seeks to provide an improved grid which may be advantageously used in IOTs in particular. However, the invention may also be applied to other types of linear beam tube such as TWTs, triodes and tetrodes.

According to the invention, a grid for an electron beam tube comprises a grid section and a focus electrode. Thus, a single element combines a grid section, which may have the same configuration and dimensions of a conventional grid, and a focus electrode. It is not therefore necessary to separately mount two elements as in a conventional system.

It is believed by the inventor that a conventional IOT grid may become significantly

distorted in operation from its original spherical profile. In a conventional arrangement, the grid is continuous at its outer periphery with a circular mounting flange by means of which it is fixed to a grid support. The grid is either integral with the mounting flange or fixed to it. During operation, the grid itself is heated by radiation from the cathode, by electron interception and by rf currents. However, the surrounding mounting flange is cooled as it is clamped to a substantial support structure which acts as a heat sink. As a result, expansion of grid wires across the grid diameter with increasing temperature causes the centre of the grid to move closer to the cathode than the periphery of the grid, the position of which is fixed by the mounting flange. The profile of the grid thus distorts from the generally spherical shape, resulting in variation of electron current density with radius.

Accordingly, in a particularly advantageous embodiment of the invention, an accommodation portion is included, preferably between the grid section and the focus electrode, which is deformable. The accommodation portion of the grid allows for differential expansion between the grid section and the mounting flange caused by temperature differences. The grid section is relatively rigid compared to the accommodation portion. Thus, although the members making up the grid section expand, the distortion of the grid section from a spherical profile, as occurs with a conventional grid, is much reduced as the deformable accommodation portion does not restrict the outer diameter of the grid section but allows it to increase. The accommodation portion may alternatively be located between the focus electrode and a mounting flange, the outer periphery of the grid section and the focus electrode being adjacent one another. However, this arrangement is likely to be of less benefit as the focus electrode in most cases is relatively rigid and hence will tend to fix the outer diameter of grid section. However, the focus electrode will itself also expand with

temperature to some extent and is also separated from the cooler mounting flange by the accommodation portion, giving some reduction in distortion of the grid section.

In one preferred embodiment the accommodation portion comprises a plurality of axial strips arranged between the outer periphery of the grid section and the inner periphery of the focus electrode. The strips are dimensioned so that they flex radially to allow for changes in diameter of the grid section relative to the surrounding mounting flange caused by temperature differences. Other types of accommodation portion may be included providing that it is sufficiently flexible to allow the the required movement to occur and to give a structurally sound design. For example, in another embodiment, the accommodation portion may be a corrugated cylinder such that changes in the dimensions between the grid section and the mounting flange are taken up by folds of the corrugated cylinder moving towards one another. The thickness of the accommodation portion may be less than that of other parts of the grid to give increased flexibility.

The grid may be formed of pyrolytic graphite. However, the invention is also applicable to metallic grids. Although it will usually be more convenient for the parts of the grid to be formed as an integral single element, in other embodiments, parts may be fabricated separately and subsequently joined together to form the complete grid.

The grid may be part spherical in form, but the benefits of the invention are also applicable to a planar grid or to grids of some other shape.

Where the accommodation portion of the grid comprises a plurality of strips, in one

advantageous embodiment of the invention, the strips are configured such that one end of each strip is connected to the grid section and the other end of each strip to the focus electrode, or to the mounting flange as appropriate. In such an embodiment, the grid section may include radially extensive members in which case, preferably, strips of the accommodation portion are contiguous with said members. This provides a good mechanical construction which may also be readily fabricated.

Preferably, the focus electrode is contiguous with a mounting flange, which advantageously is a continuous flat annulus. However it may comprise separate discontinuous sections or provide other means for mounting the grid in a tube.

According to a first feature of the invention, an electron gun assembly comprises a grid in accordance with the present invention.

According to a second feature of the invention, a linear electron beam tube comprises a grid in accordance with the present invention.

One way in which the invention may be performed is now described by way of example with reference to the accompanying drawings, in which:

Figure 1 schematically shows in section a conventional grid;

Figure 2 schematically shows in section a grid in accordance with the invention;

Figure 3 shows schematically and in perspective the grid of Figure 2; and

Figure 4 schematically illustrates an IOT in accordance with the present invention.

With reference to Figure 1, a conventional grid for use in an IOT, for example, comprises a grid 1 having crossing wires, typically in a pattern comprising radial spokes with circumferential rings connecting them. A mounting flange 2 is connected to the outer periphery of the grid 1 and has a plurality of apertures therethrough (not shown) via which pins of a relatively massive grid support are located to secure the grid in position in the tube. A separate beam focussing electrode, such as a Wehnelt cylinder, at grid potential may also be included to control the beam profile and conventionally is a separate massive metal component.

With reference to Figures 2 and 3, a grid in accordance with the invention includes a grid section 3, a focus electrode 4 and a accommodation portion 5 extending between them. A mounting flange 6 is contiguous with the outer periphery of the focus electrode 4.

The grid section has a spherical profile and comprises conductive radially extending supports 7 spaced equidistantly from one another and circumferential rings 8 to which they are connected, only some of which are shown. Other configurations may, of course, be used instead. In this embodiment, the accommodation portion 5 comprises a plurality of thin strips 9 extending generally axially between respective ones of the radial supports 7 of the grid section 3 and the inner periphery 4a of the focus electrode 4, the axial direction being the longitudinal axis of the tube parallel to the electron beam path. In this case, the number of strips 9 corresponds to the number radial supports 7. The focus electrode 4 controls the

beam profile, and in this embodiment is configured as a Wehnelt cylinder.

The grid is of pyrolytic carbon and is formed as a single element. It is fabricated by depositing the carbon on a former which defines the shapes of the mounting flange, focus electrode, cylindrical accommodation portion and the spherical profile of the grid section. The required grid section profile and the strips of the accommodation portion are then defined by laser cutting. The strips of the accommodation portion are arranged to have a similar width and thickness to the radial supports of the grid section 3.

During operation of the IOT, the strips 9 are able to flex in a radial direction and to deform to allow for difference in the changes in diameter between the relatively rigid grid section 3 and the focus electrode 4 and the mounting flange 6 due to temperature differences.

Figure 4 schematically illustrates an IOT in accordance with the invention. It comprises a cathode 14 having a spherical front surface 15 in front of which is located a grid 16 of the type shown in Figures 2 and 3. The grid 16 includes a grid section 17, a focus electrode 18 and accommodation portion 19. A cylindrical resonant input cavity 20 surrounds the electron gun structure 21. An output resonant cavity 22 is used to extract an amplified signal following its interaction with the electron beam produced by the cathode 14. A collector 23 is arranged to receive electrons of the beam after they have travelled through the resonant cavity 22. The grid with its integral focus electrode provides all of the focussing of the electron beam. It is not necessary to include any additional focus electrode.

Claims

1. A grid for an electron beam tube comprising a grid section and a focus electrode.

2. A grid as claimed in claim 1 and including an accommodation portion which is deformable.

3. A grid as claimed in claim 2 wherein the accommodation portion comprises a plurality of axial strips.

4. A grid as claimed in claim 3 wherein the strips are arranged such that one end of each strip is connected to the grid section and the other end to the focus electrode or to a mounting flange.

5. A grid as claimed in claim 4 wherein the grid section includes radially extensive members and strips of the accommodation portion are contiguous with said members.

6. A grid as claimed in any one of claims 2 to 5 wherein the accommodation portion is located between the grid section and the focus electrode.

7. A grid as claimed in any preceding claim which is wholly of pyrolytic graphite.

8. A grid as claimed in any preceding claim wherein the grid section is part-spherical.

9. A grid as claimed in any preceding claim and includes a mounting flange which is

contiguous with the focus electrode.

10. An electron gun assembly comprising a grid as claimed in any preceding claim.

11. A linear electron beam tube comprising a grid as claimed in any of claims 1 to 9.

12. A grid for an electron beam tube substantially illustrated in and described with references to Figures 2 and 3, or 4 of the accompanying drawings.

13. An electron gun assembly substantially as illustrated in and described with reference to Figure 4 of the accompanying drawings.

14. An IOT substantially as illustrated in and described with reference to Figure 4.

Application No:	GB 9812469.6	**Examiner:**	Martyn Dixon
Claims searched:	all	**Date of search:**	15 July 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H1D (DKDE,DKDF,DKDG,DKDH,DKDJ,DKDP,DKDX)

Int Cl (Ed.6): H01J (1/46,3/02,23/02,23/06,23/065,23/07,23/075,23/08,23/083)

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1234517 A	(Alcatel-Heurtey) see especially page 2, lines 75-80	1
X	WO 80/00282 A	(Varian) see fig 4 and page 6, lines 11-15	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.